Investment in Innovations as Value Driver: Review of Empirical Studies and Analysis of Impact on ValueCreation in Emerging Markets

Andrei B. Ankudinov
Head of the Department of Financial Management
Kazan State Financial and Economics Institute
Kazan, Russia
E-mail: ankudia@mail.ru

Liliya A. Safina
Senior Lecturer, Department of Financial Management
Kazan State Financial and Economics Institute
Kazan, Russia
E-mail: safina.la@gmail.com

Abstract

Within the perspective of discussion over various aspects of strategic value creation this paper investigates the degree and direction of the influence investment in innovation has on value creation in emerging markets. An analysis of empirical studies in the area is presented as well as the results of numerical testing of the formulated hypothesis. Our analysis confirms the validity of the hypothesis about "locomotive" nature of investment in innovations in emerging markets.

Keywords: investment in innovations, empirical studies, Kolmogorov-Smirnov test, multiple regression model.

1. Introduction

Investment in innovations is generally considered to be one of the most important factors of strategic value creation. However, the degree and direction of influence of this factor are not always exactly predictable. While in the efficient capital markets investment in innovation is the major source of quasi-rents, in emerging capital markets, generally characterized as informationally inefficient and opaque, the less cumbersome sources of quasi-rents are readily available, including the opportunity to undertake risky investments at the expense of wide range of nonfinancial stakeholders as well as creditors. High levels of corruption as well as weak law enforcement provide ample opportunities for insiders to profit from risky investments while the perceived cost of equity for the abovementioned reasons by no means reflects risks incurred. This makes the degree and direction of the impact of investment in innovation on value creation in emerging markets much less clear, which emphasizes the relevance of research carried out.

2. Empirical Evidence Review and Hypothesis

Extensive literature is devoted to various aspects of interrelationship between investment in innovations and value creation. The thirst group of studies analyzes the impact of investment in R&D on the growth option value, which is equal to the present value of future growth opportunities. Tong and Reuer (2004) carried out an empirical analysis, which examined internal and external corporate development activities of a panel of 293 manufacturing firms between 1989 and 2000. The results indicate that investments in research and development and in joint ventures contribute to growth option value, and that investments in fixed assets and in acquisitions have no effect in general. Similar research was conducted by Pirogov and Salomykova (2007) on a sample of companies from Russia, India and Brazil.

Regression analysis on panel data, as well as the construction of standard regressions on a sample consisting of 57 companies between 2002 and 2005, revealed a positive relationship between growth option value and investing in R&D for companies with positive growth option value. Relationship between the growth option and R&D spending in developed markets was considered by Alonso, Palenzuela, Herrero (2006); Garner, Jouahn, Ottoo (2002); Yap (2006). All authors confirm the hypothesis of a positive relationship between R&D expenditures and the value of real option of growth. Another line of research concentrates on relationship between announcement about investment in research and development and changes in market values of the shares. Jarrell, Lehn and Marr (1985) proved the announcement of increase in spending on research and development leads to increase in share value.

Studying the behavior of stock prices after the announcement of plans for investment McConnell and Muscarella (1985) also found that it generally leads to an increase in share prices, while the reduction of investment results in share price decline. Gollotto and Kim (2003) found that stock prices of Internet companies that had invested heavily in R&D, significantly increased in subsequent years. Johnson, Lewis and Pazderka (1993) came to similar results, conducting research on a sample of Canadian companies. Similar studies were conducted by Chan, Martin and Kensinger (1990) on a sample of 95 companies for the period between June 1979 and June 1985. They revealed that market reaction to the announcement of investment in innovation depends on the industry sector: it is positive for high-tech companies; negative – for the low-tech ones. However, the authors established a positive relationship between shareholder wealth and investments in innovation. Moreover, it was established that market reacts positively to the aggressive policies of investment in innovation, even if the earnings per share decline. Another direction of research involved determination of the optimal size of investment in innovation which maximizes corporate value.

Needham (1975) assumed that prices of goods or services depend on the level of expenditures on R&D; he also concluded that setting the optimal level of R&D expenditures is similar to optimization of expenditures on advertising and sales promotion. The rationale for this conclusion lies in the fact that the effect of R&D expenditures, reflected in the price will be similar to the effect of the cost of advertising and sales promotion. However, the latter assumption can be viewed as realistic only in case of a guaranteed appearance of a new product in the marketplace. That in turn is by no means secured by the very fact of investment in research and development: the nature of these costs (R&D and advertising and sales promotion) is not identical, and hence the mechanisms of their influence on the prices are likely to be different. Kamien and Schwartz (1978) advocated the position that investments in R&D should be carried out up until substitute products of competing companies appear in the marketplace. However, the proposed optimization model of R&D expenditures emphasized expected profit maximization rather than wealth maximization. Davis and Owens (2003) studied the influence investments in power-saving technology have on corporate value with positive effect being discovered. The research proved that it is the very fact of acceptance of investments in the R&D project that increases share value rather than its successful completion.

However valuable this conclusion is for the purposes of our analysis, one has to concede that this kind of relationship can hold only for highly efficient and transparent capital markets. Weak informational efficiency combined with poor corporate governance would most probably focus the market on the actual results of investments in the R&D project. Generally, the body of research available, however insufficient is it for emerging markets, allows us to conclude that both for developed and developing capital markets investments in research and development have positive influence on the company value. However thin to the current date is literature on the impact of investments in R&D on value creation in the emerging markets, it allows us to formulate the following hypothesis H:

In opaque market investment in innovations should not be viewed as a separate value driver: it is rather a directing force, activating other value drivers. In other words we are going to check the so-called "locomotive" character of innovations.

As the most expedient measurement tool for innovation-based value creation we chose the adjusted for R&D expenditures Economic Value Added ($EVA_{adj.}$). Detailed discussion of this indicator as a financial performance metric was presented by Safina L. (2010).

According to the hypothesis formulated above, R&D expenditures made during period T will be effective after certain period of time, having greatest influence on adjusted for R&D expenditures EVA at time T+n ($EVA_{[T+n]}$), where n is the weighted average payback period of the of the company's innovative projects portfolio. At the same time R&D expenditures during period T will have less impact on $EVA_{[T+n-X]}$ and $EVA_{[T+n+X]}$.

3. Method and Data

In order to test our hypothesis we create a diagram of the coefficient of separate determination obtained as a result of building multiple regression models. The latter are used to test the impact investments in innovations have on the resulting indicator – EVA_{adj}. In case obtained results are normally distributed our hypothesis is confirmed. Financial statements of 58 innovative enterprises in Tatarstan region, covering the period between 2000 and 2009 were used. Selection of the factors to be included in the multiple regression models was made using factor analysis procedure. At the first stage of the analysis the main components were determined using Kaizer criterion. According to the number of factors found at the first stage the determination of factor loadings was performed. After selection procedure the multiple regression model was developed. In our research we used standard regressions based on the least squares method.

To evaluate the degree of influence the factors have on the dependent variable we used coefficient of separate determination that was calculated using the following formula

$$d_x = r_{yx_i} \times \beta_{x_i},$$

where r_{yx_i} denotes bivariate correlation coefficient between the resulting indicator and factor number *i*;

β_{x_i} denotes standardized coefficient (Beta) in multiple regression equation.

In order to evaluate statistical significance of the developed models calculation of the Fischer-Snedecor F-criteria value was carried out, which represent unbiased estimate of the dependent variable variance, stipulated by regression or explanatory variable as well as the influence of unaccounted random factors and errors, respectively.

Since our purpose is to establish whether F-coefficients are significant, we introduce a competing hypothesis H_o which maintains insignificance of this relation, and verify it. Comparing the tabulated value of F-criterion, calculated at the significance level of α=0,05 at the degrees of freedom of k_1=m-l and k_2=n-m, with F - statistic it is possible to verify the hypothesis of statistical significance of the regression equation. Due to the fact that in all developed models $F_{tabul.}$ < F statistic with the probability of 1- α= 0.95 we conclude that H_0 hypothesis should be rejected, which in turn proves the statistical significance of regression equations in general and that of R^2.

Durbin-Watson statistics as well as zero mean residuals also prove the stability of the model. The distribution of coefficient of separate determination is presented in Figure1. To check the shape of distribution of the obtained variable d_{exp}. for R&D a Kolmogorov-Smirnov test was performed using SPSS 15.0. Results presented in Table 1 include: the average value and the standard deviation; the intermediate results obtained by means of the Kolmogorov-Smirnov test; error probability p. The deviation from the normal distribution is considered significant if p < 0.05. In our case p = 0.943, so the probability of an error is insignificant, and the variable can be viewed as normally distributed.

4. Summary

The evidence provided by the analysis performed allows us for the following conclusions:

- Investments in innovations generally have positive impact on the company value.
- Our hypothesis of a “locomotive” nature of the innovations has been confirmed.
- At the regional level the payback period of innovative projects is equal to eight years in average, which corresponds to the period characterized by maximum coefficient of separate determination $d_{exp.\ for\ R\&D.}$

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Figure 1: Distribution of coefficient of separate determination dexp. for R& D

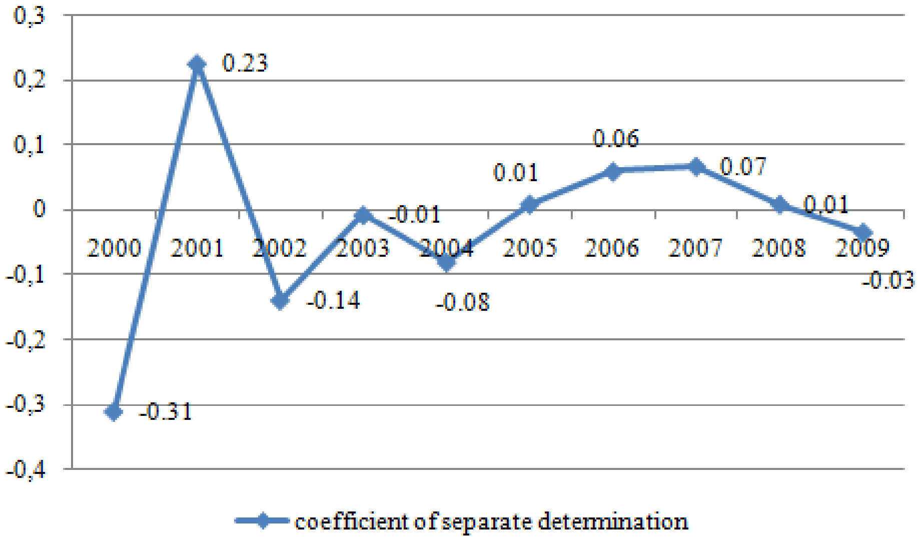

Table 1: Results of Kolmogorov-Smirnov test for the verification of distribution shape of the variable "Coefficient of separate determination $d_{\text{exp. for R\&D}}$"

		$d_{\text{exp. for R\&D}}$
Number		10
Normal Parameter [a, b]	Mean	-0.0197
	Std. Deviation	0.14058
Extreme Differences	Absolute	0.167
	Positive	0.167
	Negative	-0.159
Kolmogorov-Smirnov Z		0,528
Asymp. Sig. (2-tailed)		0,943

a Distribution is Normal
b Calculated on the basis of initial data

Table 2 : Coefficients from the multiple regression model [a,b,c]

	Coefficient β(Beta)	Std. error of the estimate	Coefficient b	Std. error of the estimate	t-value	Sig. level	Bivariate correlation coefficient	Coefficient of separate determination
$R\&D_{2000}$	0.9098	0.1492	42.8494	7.0284	6.0966	0	-0.34	-0.3097
$R\&D_{2001}$	-0.6129	0.1411	-10.347	2.3822	-4.3433	0.0001	-0.368	0.2256
$R\&D_{2002}$	0.3066	0.0393	26.3843	3.3861	7.7919	0	-0.451	-0.1384
$R\&D_{2003}$	0.1121	0.0306	5.6177	1.5319	3.6671	0.0006	-0.059	-0.0066
$R\&D_{2004}$	-0.2839	0.0749	-6.0097	1.5857	-3.7898	0.0004	0.2828	-0.0803
$R\&D_{2005}$	-0.2905	0.0118	-2.2913	0.0931	-24.601	0	-0.036	0.0105
$R\&D_{2006}$	-0.2706	0.0423	-0.9118	0.1424	-6.4012	0	-0.215	0.0581
$R\&D_{2007}$	-0.2719	0.0282	-1.0426	0.108	-9.6515	0	-0.249	0.0677
$R\&D_{2008}$	-0.0542	0.0645	-0.1817	0.2165	-0.8394	0.4057	-0.184	0.0099
R&D2009	-0.0822	0.0343	-1.0704	0.4466	-2.3969	0.0204	0.4155	-0.0341

a Dependent variable: $EVA_{adj \cdot 2009}$
b Independent variable: $R\&D_{2000\text{-}2009}$
c Other independent variables not presented here

Table 3 : Parameters of testing the statistical significance of the multiple regression models

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
R Square	0.973	0.962	0.995	0.987	0.978	0.998	0.998	0.999	0.995	0.988
Adjusted R Square	0.968	0.954	0.994	0.985	0.972	0.998	0.997	0.999	0.993	0.986
Durbin-Watson	2.239	1.919	2.140	1.504	1.625	2.072	1.730	1.738	1.929	2.176
F-statistic	190.56	118.61	931.87	549.45	181.69	1986.6	1628.2	3576.7	705.7	511.21
$F_{tabul.}$	2.807	2.643	2.643	3.319	2.515	2.412	2.412	2.515	2.412	3.022
Residuals	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000